ABSTRACT

STRATEGIES FOR DEVELOPING
ELECTROCHEMICAL BIOSENSORS
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New strategies for electrochemical biosensors have been developed to improve the sensitivity, selectivity, speed, and stability of the measurement of compounds of biological interest. Biological and chemical surface modification schemes, as well as adsorptive accumulation, have been employed. Enzyme-containing tissues were used to prepare a new type of amperometric sensor, a mixed plant tissue-carbon paste bioelectrode or a dual electrode configuration with a tissue generator reactor. The speed advantage is attributed to the elimination of diffusional barriers between the biocatalytic and sensing sites. These bioelectrodes are well suited to biosensing applications, evaluation of biological materials, and characterizing the kinetic behavior of the enzyme in the tissue.

An electropolymerization scheme was used to prepare a size-selective polyphenol oxide film on the platinum electrodes. The selectivity of the membrane was controlled by the use of various monomer concentrations. This modification scheme is very suitable for preparing a size-selective membrane for species of molecular weights between 50 - 200 a.m.u. A new Eastman AQ polymer is used for fabricating a charge selective membrane by dip coating on a graphite epoxy capillary electrode. This polymer demonstrated properties similar to Nafion^{TM} and was very suitable for developing a selective sensor for the measurement of neurotransmitters in the presence of ascorbic acid.

A rapid in situ electrochemical scheme for the renewal of the surface of glassy carbon electrodes was developed. This modification scheme can effectively removed the passivating layer. In contrast to the untreated glassy carbon electrode, the treated electrode provided significant stability in measurements which were demonstrated by a series of cyclic voltammograms. The conditions of treatment, such as potential limits, frequency, and duration, depended upon the nature of the passivating materials.

An effective preconcentration scheme, followed by voltammetric measurement, or adsorptive stripping voltammetry, was used to monitor the therapeutic drugs. This surface preconcentration scheme was achieved by the optimization of the preconcentration potential, deposition time, solution pH, and ionic strength. These strategies greatly enhance the power of electroanalysis in the area of clinical medicine.